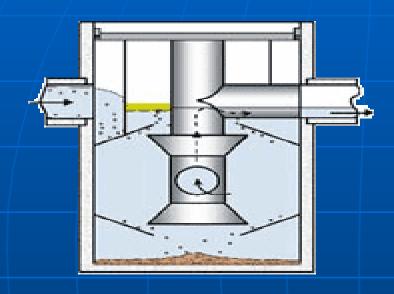
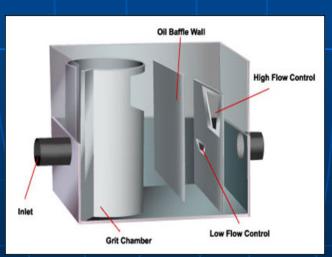
Preliminary Look at Method for Sizing Proprietary Sediment Settling Devices

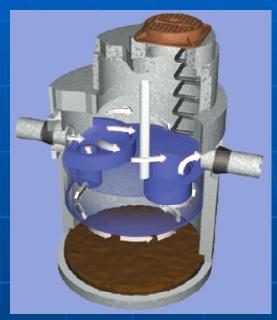
Roger Bannerman Judy Horwatich Jim Bachhuber December 7, 2004

Examples of Proprietary BMPs Using Settling for Treatment



Downstream Defender

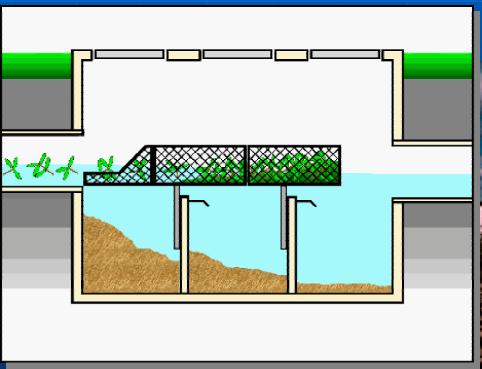




Stormceptor

Vortechs

Why Not Use Methods for Designing Detention Ponds to Develop a Sizing Criteria for Proprietary Treatment Practices – Both Rely on Settling



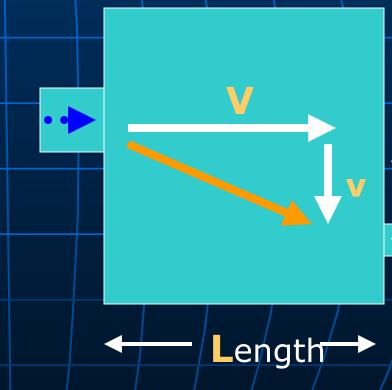




Detention Pond

Critical Velocities and Detention Pond Dimensioins

Path of particle is the vector sum of the water velocity (V) in the pond and the particle settling velocity (V).



Velocity

Velocity

Depth

Length

Upflow Velocity

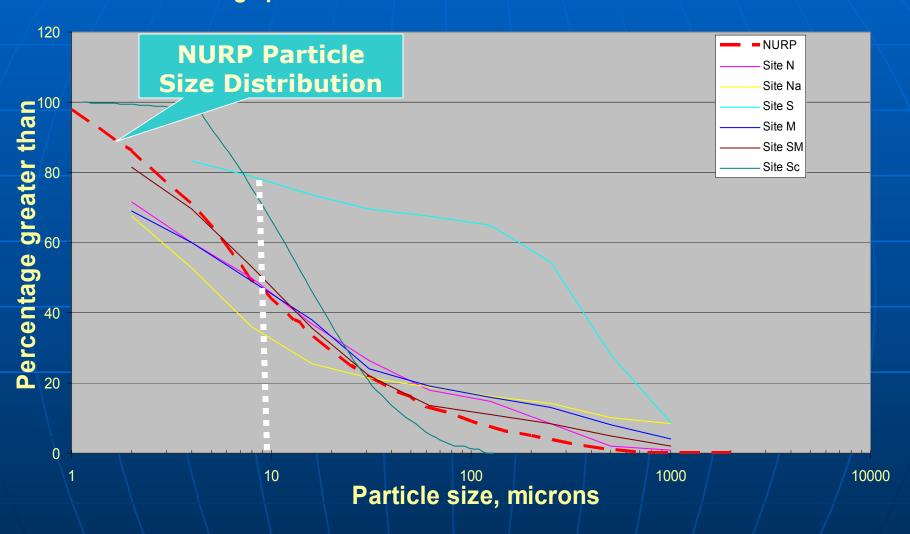
- In an ideal sedimentation pond, particles having settling velocities greater than the upflow velocity will be removed.
- Design pond to make "v" as small as practical.
- Only increasing the surface area or decreasing system discharge rate will increase removal rates.

v = Upflow Velocity – critical settling velocity

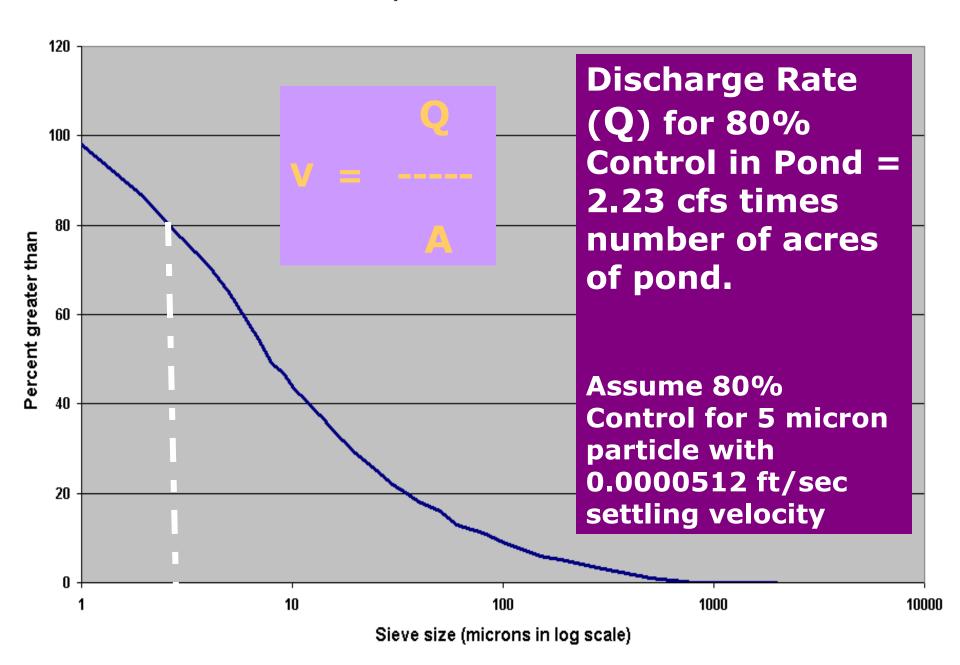
Q = Pond Outflow Rate

A = Pond Surface Area

Average particle size distrubtion for 6 monitored sites



NURP particle size distribution

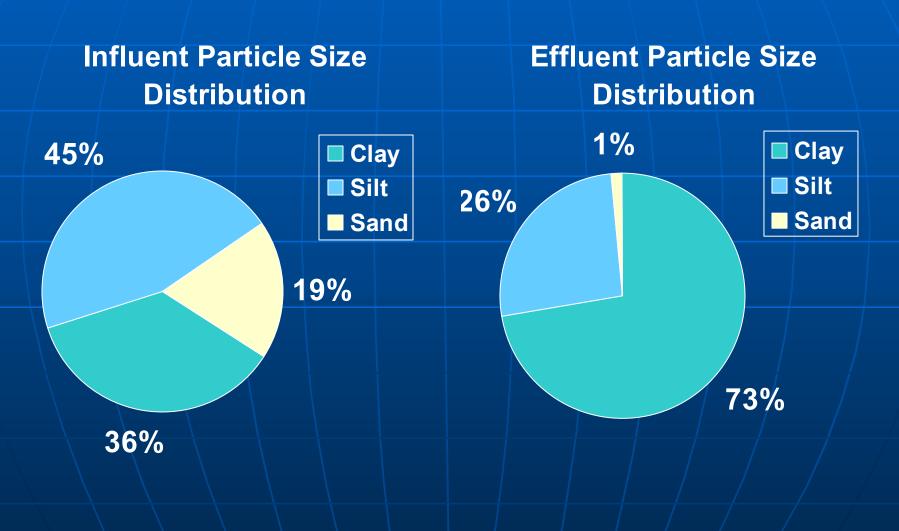




Needs for Continuous Simulation Model

- Changing Q means changing v; create flow weighted critical velocity.
- Flexibility to use different inputs eg.
 Particle size distribution, rainfall, etc.
- Account for short-circuiting.
- More flexibility in selection of outlet structures.

Influent and Effluent Particle Size Distributions for Monroe St. Pond



Models Using Upflow Velocity – Authors Robert Pitt and John Voorhees

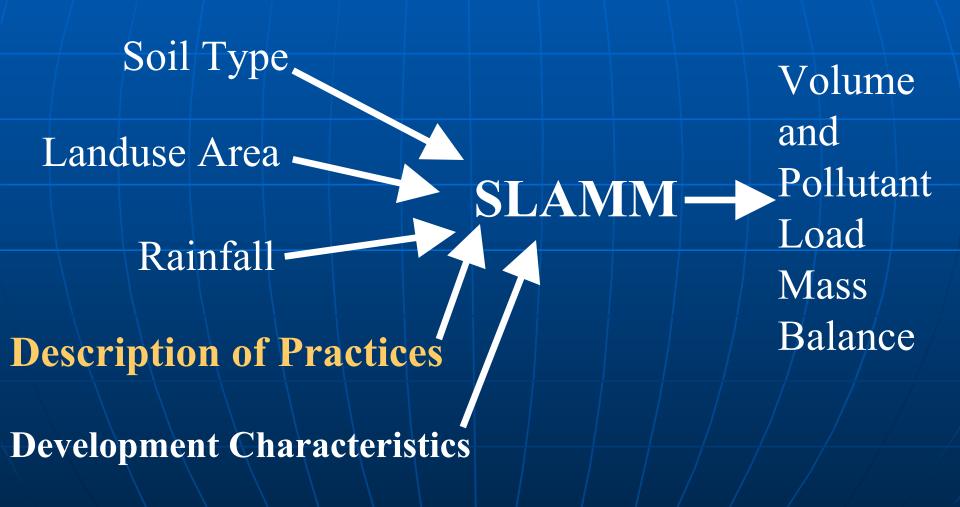
Source Load and Management Model (SLAMM)

Developed to assist cities in evaluating the benefits of alternative stormwater treatment practices for both runoff quality and quantity in existing and developing urban areas.

DETPOND

Developed to predict how much particulate solids a wet detention pond will be removed from urban runoff. Most features of DETPOND are in SLAMM.

SLAMM Inputs and Outputs



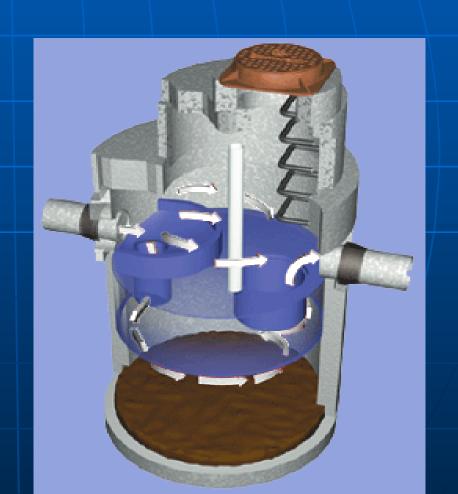
Example of Proprietary Device Monitoring

Rob Waschbusch – USGS

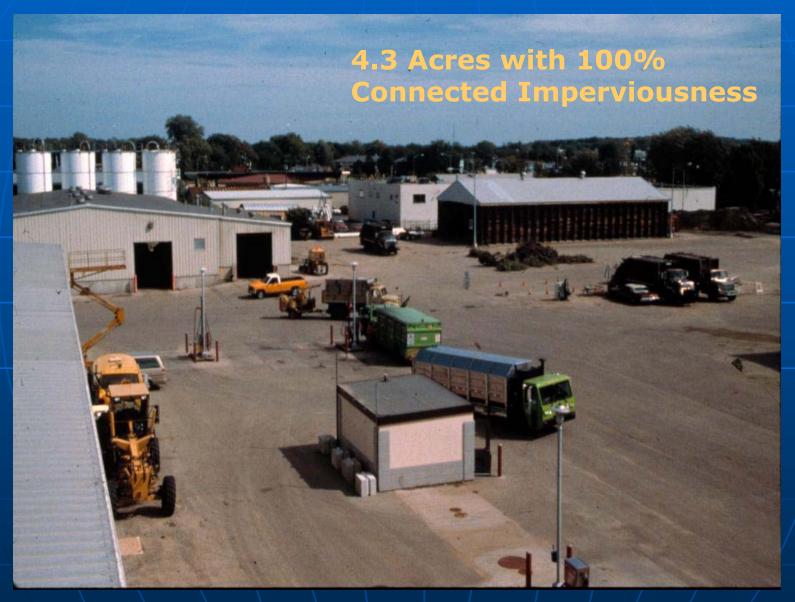
1996 to 1997

Sponsors - City of Madison and WDNR

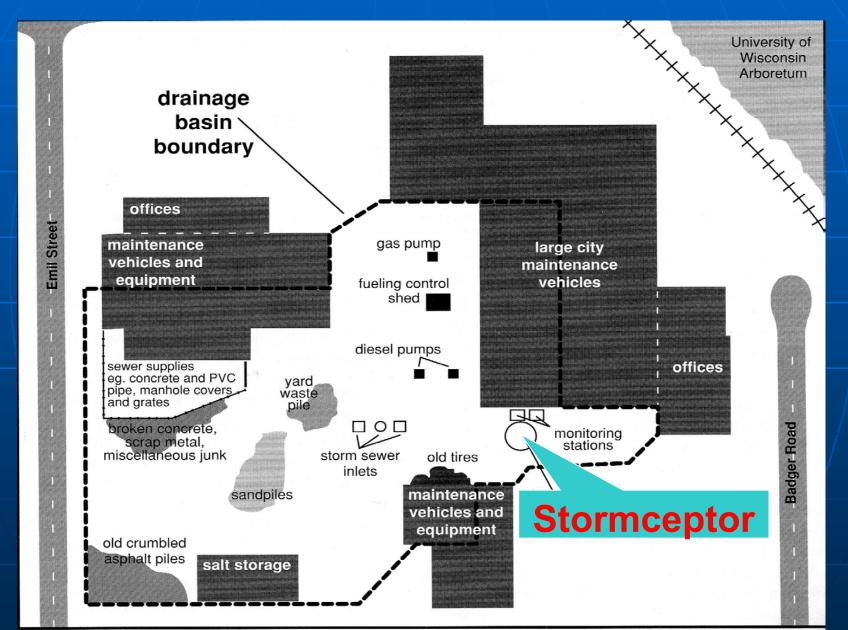
Stormceptor



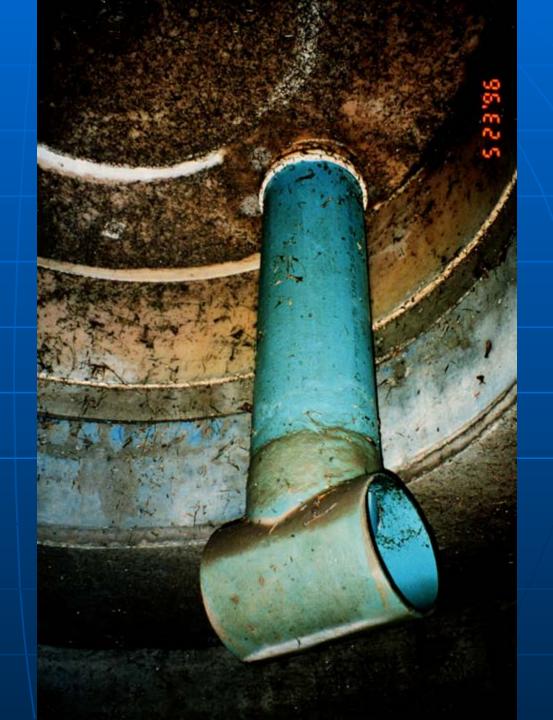
Site Conditions - Maintenance Yard



Site Conditions



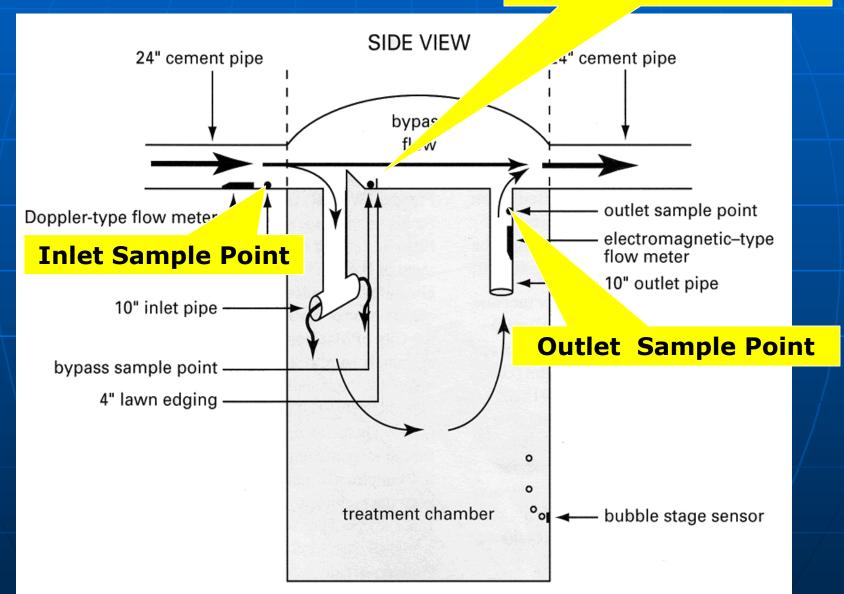
Manufacturer
Sizing
Guidelines
Claimed 80%
Removal of
Total Suspended
Solids for the
Site.





Monitoring Locations

Bypass Sample Point



Monitoring Locations

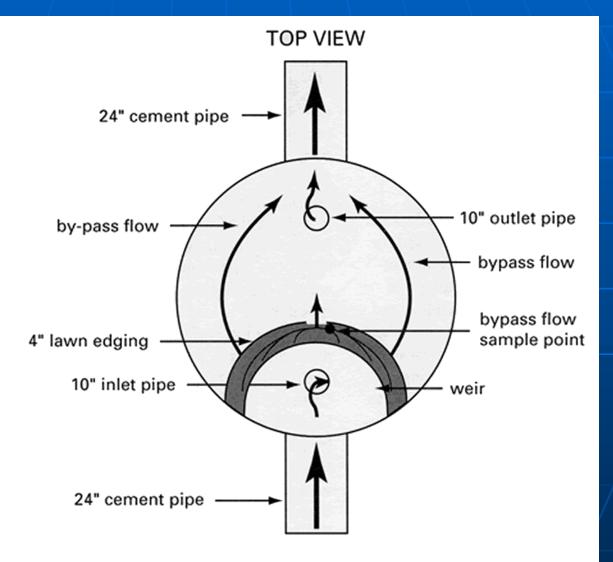


Figure 2. Diagram of stormwater treatment unit and instrumentation for the Madison, Wis., study.

Total Suspended Solids (TSS) Load Reduction Results for Stormceptor

TSS Loads, Kg.

Type of Load	Influent	Effluent	% TSS Reduction
Treated Water Only	1258	943	25%
Treated + Bypass Water	1504	1189	21%

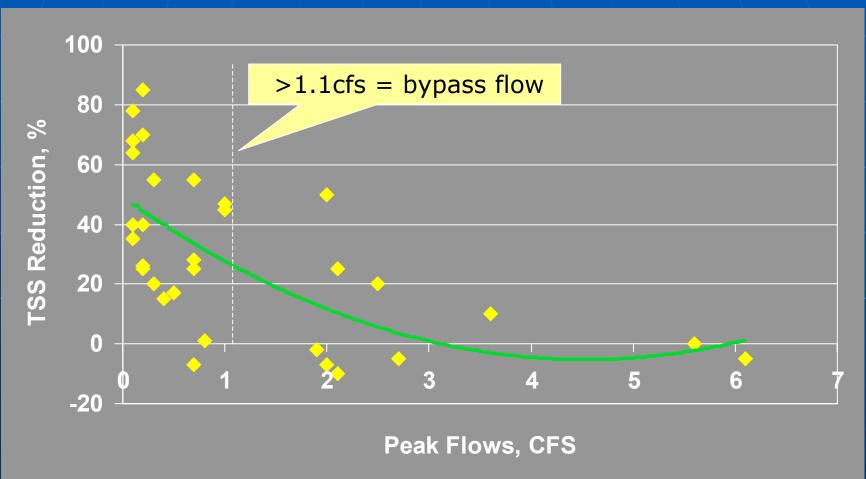
TSS Load Reduction Results Used for Model Comparison

TSS Loads, Kg.

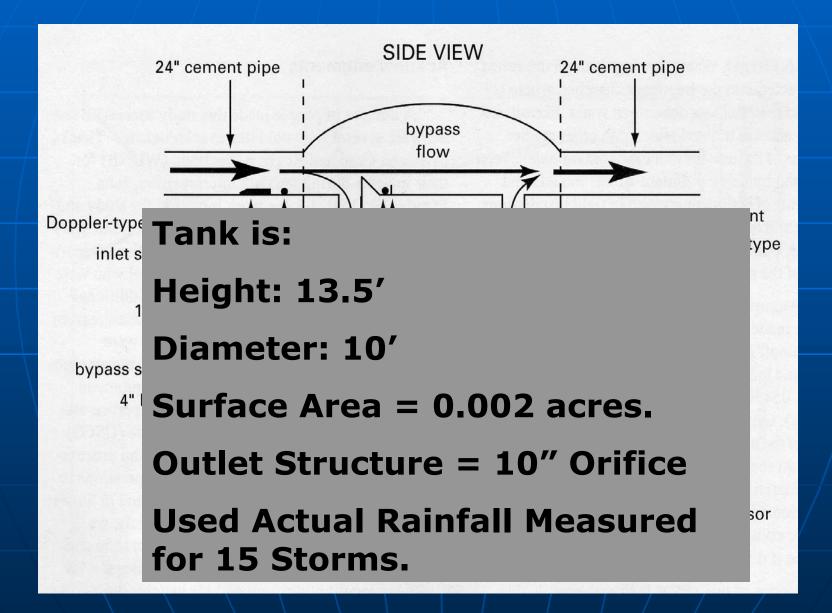
Type of Load	Influent	Effluent	% TSS Reduction
15			
Summer	250	230	8%
Events			
Winter Events	780	413	47%

TSS Reduction as a Function of Peak Discharge for the Stormceptor

(includes both treated & bypass water)



Model Input



DETPOND Input Screen:

Stage Area Values

Initial Stage Elevation (ft)

Depth of Pond that is Rock Filled (ft)

Fraction of Rock Filled Volume as Voids (0-1)

Rock Fill Min. Stone Size (in.)

0

13.5

0

0

Stage (ft)

Row 1 1.00

Sediment Accumulation Mass that Shuts Off Pond Infiltration (kg/sgm)

20

Recalculate Pond Volume

User Defined Pond Efficiency Factor, n:

5

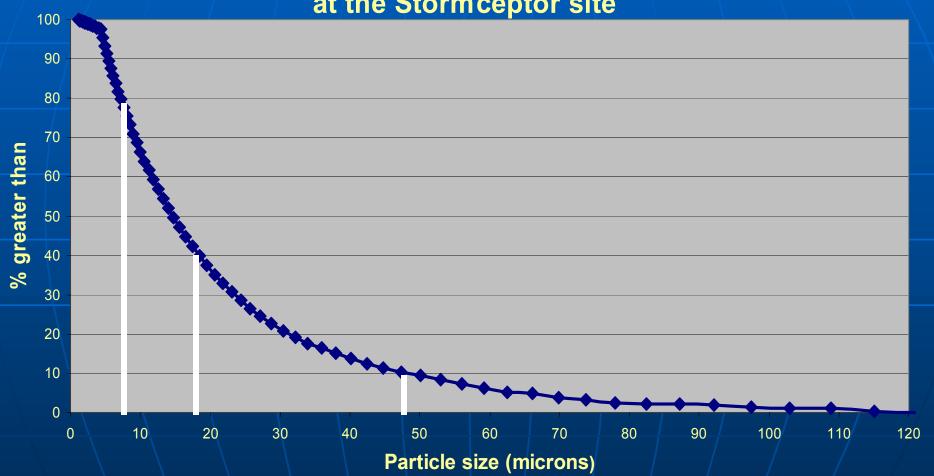
Continue

Cancel

	Stage (ft)	Area (acres)	Cumulative A Volume [ac-ft]
0	0.00	0.0000	0.000
1	1.00	0.0020	0.001
2	2.00	0.0020	0.003
3	3.00	0.0020	0.005
4	4.00	0.0020	0.007
5	5.00	0.0020	0.009
6	6.00	0.0020	0.011
7	7.00	0.0020	0.013
8	8.00	0.0020	0.015
9	9.00	0.0020	0.017
10	10.00	0.0020	0.019
11	10.20	0.0020	0.019
12	10.30	0.0020	0.020
13	13.50	0.0020	0.026

Use Shift plus the arrow keys to move through the grid. Right-mouse click on a row to delete it or insert a new row.

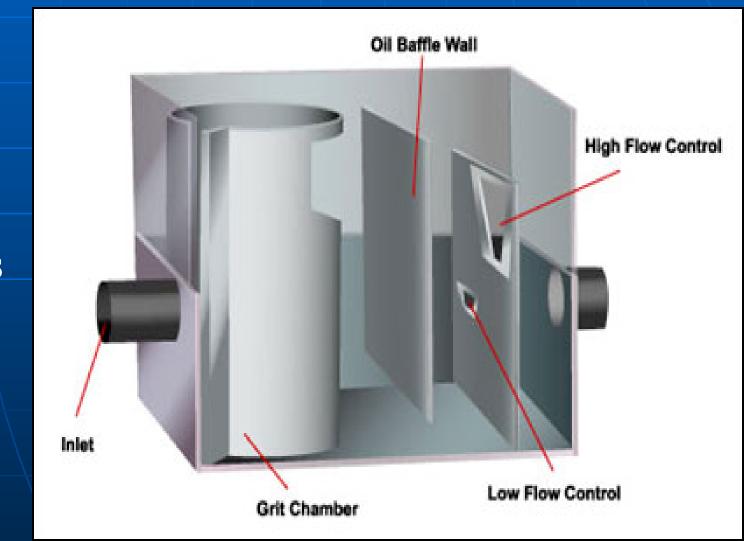
Particle size distrubution for warm weather events at the Stormceptor site



Comparison of Measured and Modeled TSS Reductions for Stormceptor

	Measured TSS	DETPOND
	Reductions	Estimates with
		Measured PSD and Rainfall
Percent		
Reduction TSS	8%	11%
Flow Weighted Ideal Particle Trapped =		
54 Microns		

Data from Monitoring Site Almost Ready to Use for Verification of Model – Apply PSD and Dimensions to Speculate on TSS Reduction.



Vortechs



Vortechs Installation: Data Collected for 20 Storms in 2003 to 2004.

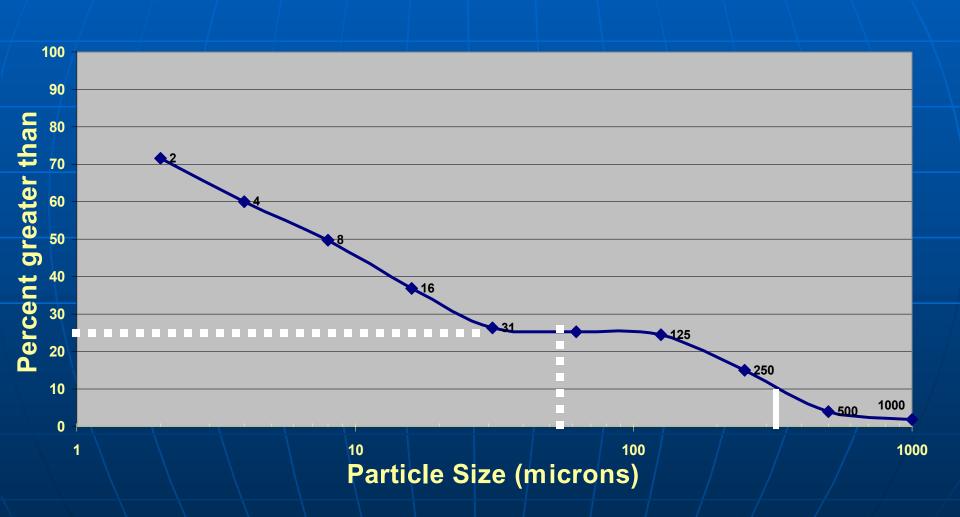


Milwaukee, WI. Test Site: I 794





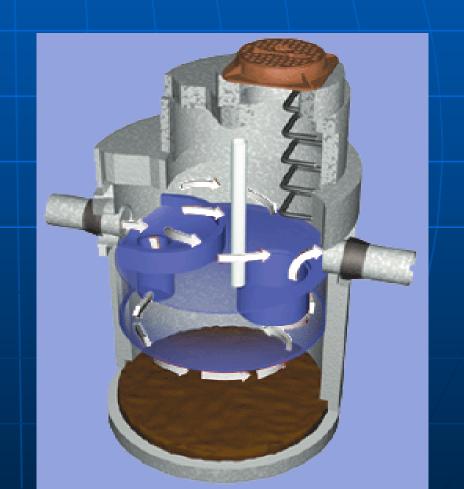
Average Particle Size Distribution for Elevated Freeway in Milwaukee (Vortechs System)



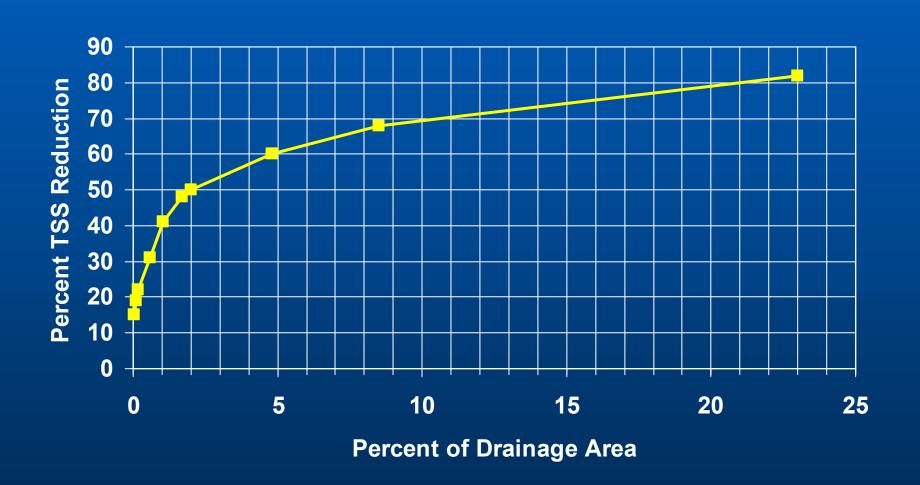
DETPOND Predicted TSS Reduction for Vortechs at I-794, Milwaukee

- Percent Reduction Using Measured Rainfall and Particle Size Distribution: 30%
- Flow Weight Ideal Particle Trapped: 40 Microns

How Big Do We Have to Make Stormceptor to Achieve TSS Performance Standards at Maintenance Yard?



TSS Reductions for Stormceptor using DETPOND (Madison Rain81 and NURP PSD)



Size of Stormceptor for Selected TSS Reductions (Madison Rain81 and NURP PSD)

Percent TSS Reduction	Diameter of Tank, Feet	Tank as a Percent of Drainage Area
15	10	0.05%
20	18	0.14%
40	50	1.05%
80	235	23%

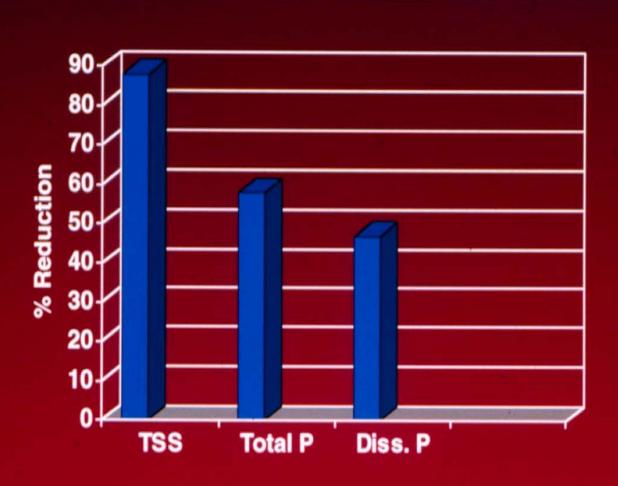
of 10' Diameter Stormceptors to Achieve TSS Reduction on a 4.3 acre Site

(Madison Rain81 and NURP PSD)

Percent TSS	Number of Stormceptors for
Reduction	4.3 acre Site
10%	1
20%	3
40%	20



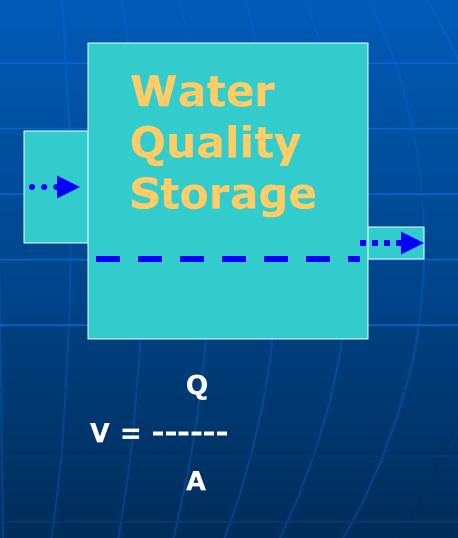
Total Load Reduction Achieved by Monroe Pond



Why Does Stormceptor Require Such a Large Surface Area (A) To Achieve Performance Standards?

 Typically, these devices do not have sufficient active storage

 Active storage is needed to allow for a small enough outlet structure (smaller Q)

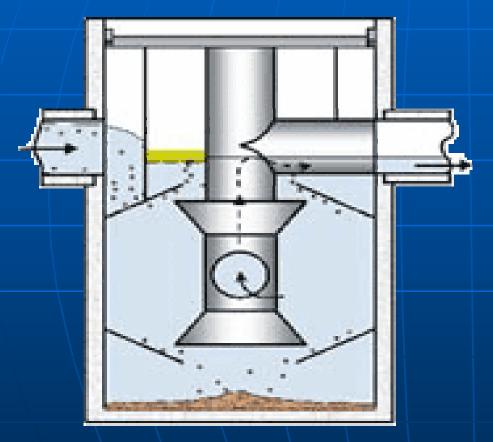


Conclusions

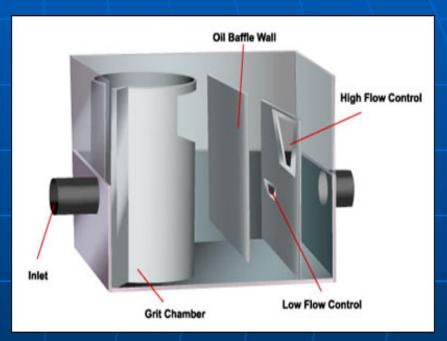
- Select Treatment Device
 Sizes that Match Site Goals.
- 80 % Control is Probably Not Practical for Most Sites.
- 40 % Control Might Work for Sites with Larger Particle Sizes.
- 20 % Control may be Practical for Most Sites.
- Models Might Do Good Job of Predicting % Control for Proprietary Settling Devices.



Conclusions are Preliminary – Future Verification of Model with Additional Monitoring Data.



Downstream
Defender: Results in about 20 months



Vortechs: Results in about 4 months

Explore Other Types of BMPs

Settling Devices:

Wet Detention Ponds

Filtration Devices:

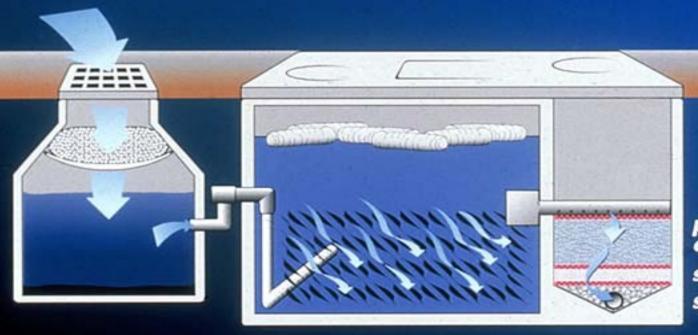
- Austin Sand Filter
- Bioretention

Combinations:

Multi-chamber Treatment Tank

Monitoring Results for Mult-Chamber Treatment Tank (MCTT)

Filter Chamber

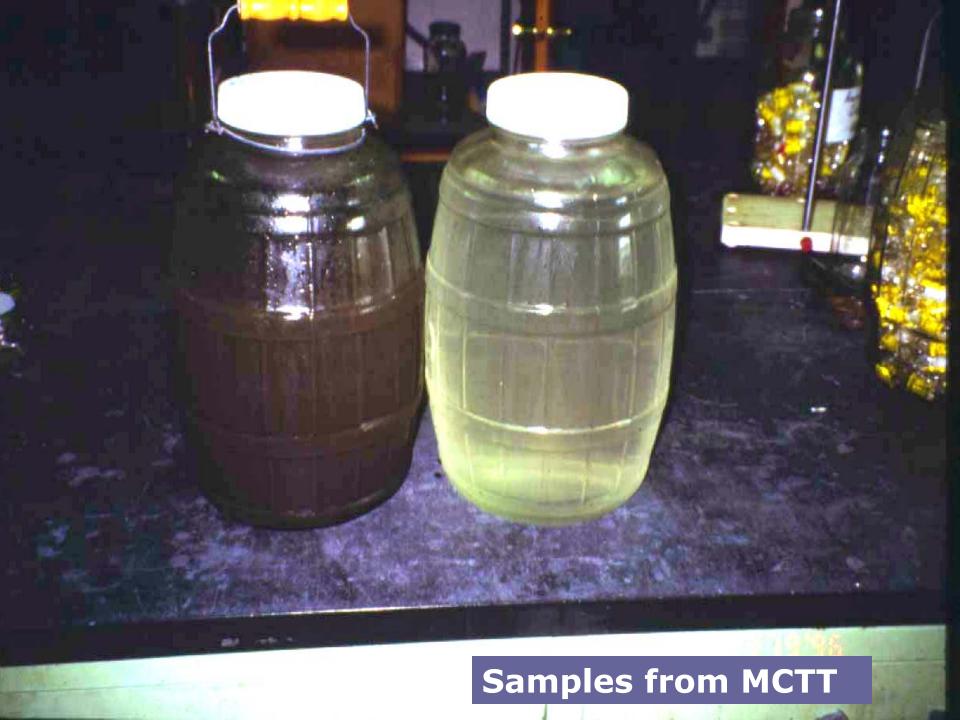


peat, sand, carbon sand stone

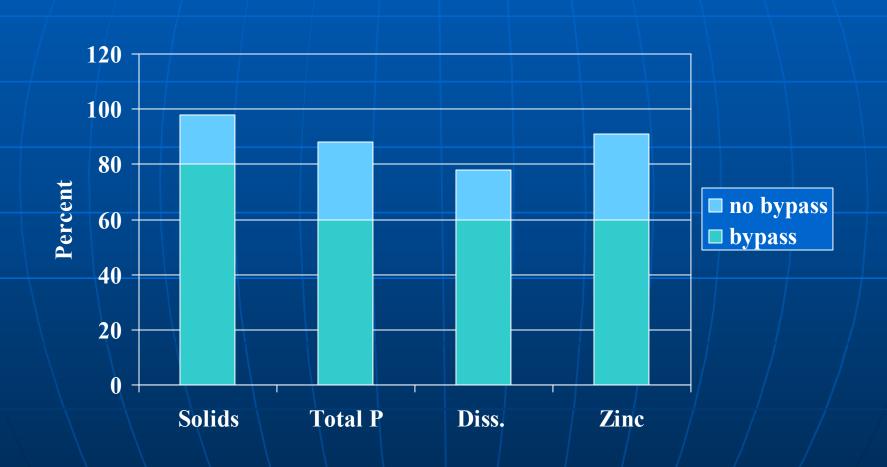




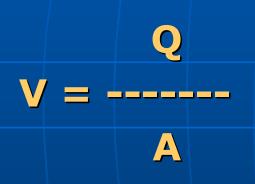


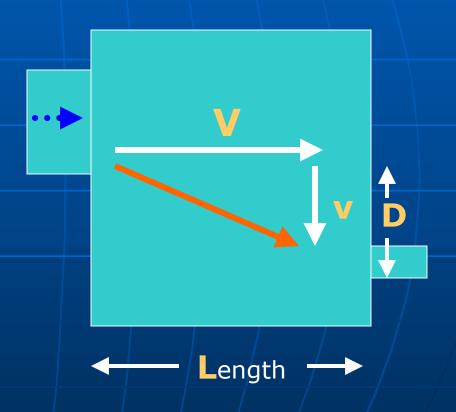


Removal Efficiencies of the MCTT



Take Advantage of What We Know.







Web Sites to Obtain Files and a Copy of SLAMM

URL:

 http://wi.water.usgs.gov/slamm/

 USGS web page for files. All updates will happen on this location. Link from DNR web page. Files will be updated in one year

 Winslamm.com - Location to purchase copy of SLAMM